

<b>National Imaging Associates, Inc.*</b>	
<b>Clinical guidelines:</b> <b>LUMBAR SPINE CT</b>	<b>Original Date: September 1997</b>
<b>CPT Codes: 72131, 72132, 72133</b>	<b>Last Revised Date: <del>April</del> March 2021</b>
<b>Guideline Number: NIA_CG_045</b>	<b>Implementation Date: January 2023</b>

## INDICATIONS FOR LUMBAR SPINE CT

\*If there is a combination request\* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:

- Inconclusive or show a need for additional or follow up imaging evaluation OR
- The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.

(\*Unless approvable in the **combination section** as noted in the guidelines)

~~(Combination requests at end of the document)~~

## For evaluation of neurologic deficits when Lumbar Spine MRI is contraindicated or inappropriate

- With any of the following new neurological deficits documented on physical exam
  - Extremity muscular weakness (and not likely caused by plexopathy, or peripheral neuropathy)<sup>1, 2</sup>
  - ~~Extremity muscular weakness~~
  - Pathologic or abnormal reflexes
  - Absent/decreased sensory changes along a particular lumbar dermatome (nerve distribution): pin prick, touch, vibration, proprioception or temperature
  - Lower extremity increased muscle tone/spasticity
  - New onset bowel or bladder dysfunction (e.g., retention or incontinence) - not related to an inherent bowel or bladder process
  - Gait abnormalities (see [Table 1](#) below for more details)
  - New onset foot drop (Not related to a peripheral nerve injury e.g., peroneal nerve)
- Cauda Equina Syndrome as evidence by severe back pain/sciatica along with one of the defined symptoms (see [Background Overview section](#))

## For evaluation of back pain with any of the following when Lumbar Spine MRI is contraindicated<sup>3-11</sup>

\* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

1—Lumbar Spine CT

© 2019-2021 National Imaging Associates, Inc., All Rights Reserved

~~(AAFP, 2012; AANS CNS, 2014; ACA, 2017; ACEP, 2014; ACR, 2015; Chou, 2007; Jarvik, 2015; Last, 2009; NASS, 2013)~~

- With new or worsening objective neurologic deficits\* on exam, as above
- Failure of conservative treatment\* for at least six (6) weeks within the last six (6) months
- With progression or worsening of symptoms during the course of conservative treatment\*
- With an abnormal electromyography (EMG) or nerve conduction study (if performed) indicating a lumbar radiculopathy. (EMG is not recommended to determine the cause of axial lumbar, thoracic, or cervical spine pain<sup>12</sup> ~~(NASS, 2013)~~)
- Isolated low back pain in pediatric population<sup>13</sup> ~~-(ACR, 2016)-~~ conservative care not required if red flags present ~~(see combination request below cervical and thoracic spine may also be indicated)~~
  - Red flags that prompt imaging should include the presence of: age 5 or younger, constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed<sup>14, 15</sup> ~~(Bernstein, 2007; Feldman, 2006)~~
  - ~~Back pain associated with suspected inflammation, infection, or malignancy~~

As part of initial pre-operative/post-operative/procedural evaluation (“CT best examination to assess for hardware complication, extent of fusion”<sup>11, 16</sup> ~~(ACR, 2015; Rao, 2018)~~ and MRI for cord, nerve root compression, disc pathology, or post-op infection)

[Note: If ordered by Neurosurgeon or orthopedic surgeon for purposes of surgical planning, a contraindication to MRI is not required.]

- For preoperative evaluation/planning
- CT discogram
- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))<sup>17</sup> ~~(Starling, 2013)~~
- A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention, or surgery in the last 6 months. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested (routine surveillance post-op not indicated without symptoms)
- ~~Changing neurologic status post-operatively~~
- Surgical infection as evidenced by signs/symptoms, laboratory, or prior imaging findings
- New or changing neurological deficits or symptoms post-operatively ~~Residual or new neurological deficits or symptoms~~<sup>16, 18</sup> ~~(Rao, 2018)~~ see neurological deficit section above
- When combo requests are submitted (see above statement<sup>†</sup>) (i.e., MRI and CT of the spine), the office notes should clearly document the need for both studies to be done simultaneously, i.e., the need for both soft tissue and bony anatomy is required<sup>19</sup> ~~(Fisher, 2013)~~

- Combination requests where both lumbar spine CT and MRI lumbar spine are both approvable (not an all-inclusive list):
  - Pathologic or complex fractures
  - Malignant process of spine with both bony and soft tissue involvement
  - Clearly documented indication for bony and soft tissue abnormality where assessment will change management for the patient

### For evaluation of trauma or acute injury<sup>20</sup>

~~(ACR, 2018)~~

- Presents with any of the following neurological deficits as above
- With progression or worsening of symptoms during the course of conservative treatment\*
- History of underlying spinal abnormalities (i.e., ankylosing spondylitis or diffuse idiopathic skeletal hyperostosis) ~~b~~ (Both MRI and CT are would be approvable)<sup>21</sup> ~~(Koivikko, 2008)~~
- When the patient is clinically unevaluable or there are preliminary imaging findings (x-ray or CT) needing further evaluation

("MRI and CT provide complementary information. When indicated it is appropriate to perform both examinations")<sup>20</sup> ~~(ACR, 2018)~~

### For evaluation of known fracture or known/new compression fractures<sup>22</sup>

~~(ACR, 2018)~~

- To assess union of a fracture when physical examination, plain radiographs, or prior imaging suggest delayed or non-healing
- To determine the position of fracture fragments
- With history of malignancy (if MRI is contraindicated or cannot be performed)
- With an associated new focal neurologic deficit as above<sup>23</sup> ~~(Alexandru, 2012)~~
- Prior to a planned surgery/intervention or if the results of the CT will change management

### CT myelogram: When MRI cannot be performed/contraindicated-/surgeon preference

- ~~is indicated~~ When signs and symptoms are incongruent inconsistent or not explained with by the MRI findings or MRI cannot be performed/contraindicated-/surgeon preference<sup>24-28</sup>

~~(Grams, 2010; Morita, 2011; Naganawa, 2011; NASS, 2012; Ozdoba, 2011)~~

- Demonstration of the site of a CSF leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula)
- Surgical planning, especially regarding to the nerve roots or evaluation of dural sac

### Pars defect (spondylolysis) or spondylolisthesis

- Pars defect (spondylolysis) or spondylolisthesis in adults when Flexion/Extension x-rays show instability
- Clinically suspected Pars defect (spondylolysis) which is not seen on plain films in pediatric population (<18 yr) (flexion extension instability not required) and imaging would

change treatment<sup>29-31</sup> ~~(Cohen, 2005; Kobayashi, 2013; Rush, 2015)~~ when MRI is contraindicated /cannot be performed or surgeon preference.

**NOTE:** Initial imaging (x-ray, or planar bone scan without SPECT; Bone scan with SPECT is superior to MRI and CT in the detection of pars intrarticularis pathology including spondylolysis)<sup>32</sup> ~~(Matesan, 2016)~~

**For evaluation of tumor, cancer, or metastasis with any of the following:**

-(MRI is usually the preferred study- CT may be needed to further characterize solitary indeterminate lesions seen on MRI)<sup>33, 34</sup>  
~~(Kim, 2012; McDonald, 2019)~~

- **Primary tumor**

- Initial staging or re-staging of a known primary spinal tumor<sup>35</sup> ~~(NCCN 2021)~~
- Known primary tumor with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings)
- With an associated new focal neurologic deficit as above<sup>23</sup> ~~(Alexandru, 2012)~~

- **Metastatic tumor**

- With evidence of metastasis on bone scan needing further clarification OR inconclusive findings on a prior imaging exam
- ~~Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the spine~~
  - With an associated new focal neurologic deficit<sup>23</sup> ~~(Alexandru, 2012)~~
  - Known malignancy with new signs or symptoms (e.g., new or increasing nontraumatic pain, radiculopathy or ~~neckback~~ pain that occurs at night and wakes the patient from sleep with known active cancer, physical, laboratory, and/or imaging findings) in a tumor that tends to metastasize to the ~~Initial imaging of new or increasing non-traumatic neck pain or radiculopathy or neck pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine~~<sup>36, 37</sup> ~~(ACR, 2018; Ziu, 2020)~~

- **For evaluation of inconclusive/indeterminate finding on prior imaging that requires further clarification**

- One follow-up exam to ensure no suspicious change has occurred in prior imaging finding. No further surveillance unless specified as highly suspicious or change was found on last follow-up exam. When MRI cannot be performed or is contraindicated or CT is preferred to characterize the finding<sup>36</sup> ~~(ACR, 2018)~~

**Indication for combination studies for the initial pre-therapy staging of cancer, OR active monitoring for recurrence as clinically indicated OR evaluation of suspected metastases**

- $\leq 5$  concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine

**For evaluation of known or suspected infection/abscess disease when Lumbar Spine MRI is contraindicated<sup>4, 38, 39</sup>**

~~(ACR, 2015; Last, 2009; Lerner, 2018)~~

- Infection:
  - As evidenced by signs and/or symptoms, laboratory (i.e., abnormal white blood cell count, ESR and/or CRP) or prior imaging findings<sup>40</sup> ~~(Bond, 2016)~~
  - Follow-up imaging of infection
    - With worsening symptoms/laboratory values (i.e., white blood cell count, ESR/CRP) or radiographic findings<sup>41</sup> ~~(Berbari, 2015)~~

**For evaluation of known or suspected inflammatory disease when MRI is contraindicated or cannot be performed<sup>42</sup>**

~~(ACR, 2021)~~

- ~~For known or suspected~~ Ankylosing Spondylitis/Spondyloarthropathies with non-diagnostic or indeterminate x-ray and rheumatology workup

**For evaluation of spine abnormalities related to immune system suppression, e.g., HIV, chemotherapy, leukemia, or lymphoma, and Lumbar Spine MRI is contraindicated<sup>38</sup>**

~~(ACR, 2015)~~

- As evidenced by signs/symptoms, laboratory, or prior imaging findings

**Other Indications for a Lumbar Spine CT, when MRI is contraindicated or cannot be performed**

(Note- See combination requests, below, for initial advanced imaging assessment and pre-operatively)

- Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata<sup>43-45</sup> ~~(AANS, 2019; Duz, 2008; Milhorat, 2009)~~
- Known anorectal malformations<sup>46, 47</sup> ~~(Kim, 2010; Morimoto, 2003)~~
- Suspicious sacral dimple (those that are deep, larger than 0.5 cm, located within the superior portion of the gluteal crease or above the gluteal crease, multiple dimples, or associated with other cutaneous markers) (D'Alessandro, 2009) or duplicated or deviated gluteal cleft<sup>48</sup> ~~(Zywicki, 2011)~~
  - in patients  $\leq 3$  months should have ultrasound
- Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity; or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))
- Known Chiari II (Arnold-Chiari syndrome), III, or IV malformation

- For follow-up/repeat evaluation of Arnold-Chiari I with new signs or symptoms suggesting recurrent spinal cord tethering (For initial diagnosis see below)
- Suspected neuroinflammatory Conditions/Diseases (e.g., sarcoidosis, Behcet's)
  - After detailed neurological exam and basic testing completed

## COMBINATION STUDIES WITH LUMBAR SPINE CT WHEN MRI IS CONTRAINDICATED OR CANNOT BE PERFORMED OR SURGEON PREFERENCE

~~Indications for combination studies<sup>49, 50</sup>: (ACR, 2017, 2019) For approved indications as noted below and being performed in a child under 8 years of age who will need anesthesia for the procedure~~

Any combination of Cervical and/or Thoracic and/or Lumbar CTs

**Note:** These body regions might be evaluated separately or in combination as documented in the clinical notes by physical examination findings (e.g., localization to a particular segment of the spinal cord), patient history, and other available information, including prior imaging.

Exception- Indications for combination studies<sup>49, 50</sup>: Are approved indications as noted below and being performed in children who will need anesthesia for the procedure }

- Any combination of these studies for:
  - Survey/complete initial assessment of infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10<sup>51-53</sup> (e.g., congenital scoliosis, idiopathic scoliosis, scoliosis with vertebral anomalies)
  - In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning<sup>54</sup>
  - Back pain with known vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging
  - Scoliosis with any of the following<sup>55</sup>:
    - Progressive spinal deformity;
    - Neurologic deficit (new or unexplained);
    - Early onset;
    - Atypical curve (e.g., short segment, >30° kyphosis, left thoracic curve, associated organ anomalies);
    - Pre-operative planning; OR
    - When office notes clearly document how imaging will change management
- Arnold-Chiari malformations<sup>56, 57</sup>
  - Arnold-Chiari I
    - For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered

- **Arnold-Chiari II-IV** - For initial evaluation and follow-up as appropriate

- Any combination of Cervical and/or Thoracic and/or Lumbar CTs

- ~~Scoliosis survey in infant/child with congenital scoliosis or juvenile idiopathic scoliosis under the age of 10<sup>47-49</sup> (ACR, 2018; SRS, 2019; Strahle, 2015)~~

- In the presence of neurological deficit, progressive spinal deformity, or for preoperative planning<sup>50</sup> (Trenga, 2016)

- Back pain and vertebral anomalies (hemivertebrae, hypoplasia, agenesis, butterfly, segmentation defect, bars, or congenital wedging) in a child on preliminary imaging

- ~~Scoliosis with any of the following<sup>51</sup> (Ozturk, 2010):~~

- Progressive spinal deformity;
- Neurologic deficit;
- Early onset;
- Atypical curve (e.g., short segment, >30° kyphosis, left thoracic curve, associated organ anomalies);
- Pre-operative planning; OR
- When office notes clearly document how imaging will change management

- ~~Arnold Chiari I<sup>52, 53</sup> (Radic, 2018; Strahle, 2011)~~

- For evaluation of spinal abnormalities associated with initial diagnosis of Arnold-Chiari Malformation. (C/T/L spine due to association with tethered cord and syringomyelia), and initial imaging has not been completed<sup>41, 49</sup> (Milhorat, 2009; Strahle, 2015)

- ~~Arnold Chiari II-IV~~

- For initial evaluation and follow up as appropriate

- ~~Tethered cord, or spinal dysraphism (known or suspected) based on preliminary imaging, neurological exam, and/or high-risk cutaneous stigmata.<sup>39-41</sup> (AANS, 2019; Duz, 2008; Milhorat, 2009), when anesthesia is required for imaging<sup>54</sup> (Hertzler, 2012)~~

- Toe walking in a child when associated with upper motor neuron signs, including hyperreflexia, spasticity, or orthopedic deformity with concern for spinal cord pathology (e.g., pes cavus, clawed toes, leg or foot length deformity (excluding tight heel cords))

- Back pain in a child with any of the following red flags (conservative care not required when red flags present):

- Red flags that prompt imaging should include the presence of: age 5 or younger,



~~constant pain, pain lasting >4 weeks, abnormal neurologic examination, early morning stiffness and/or gelling; night pain that prevents or disrupts sleep; radicular pain; fever; weight loss; malaise; postural changes (e.g., kyphosis or scoliosis); and limp (or refusal to walk in a younger child <5yo) AND initial radiographs have been performed<sup>12,13</sup> (Bernstein, 2007; Feldman, 2006)~~

- Drop metastasis from brain or spine (imaging also includes brain; CT spine imaging in this scenario is usually CT myelogram) - [See Background Overview](#)
- Suspected leptomeningeal carcinomatosis (LC)<sup>59</sup> - [See Background Overview](#) (Shah, 2011)
- Any combination of these for spinal survey in patient with metastases
- Tumor evaluation and monitoring in neurocutaneous syndromes - [See Background](#)
- CSF leak highly suspected and supported by patient history and/or physical exam findings (leak (known or suspected spontaneous (idiopathic) intracranial hypotension (SIH), post lumbar puncture headache, post spinal surgery headache, orthostatic headache, rhinorrhea or otorrhea, or cerebrospinal-venous fistula -preferred exam CT myelogram))<sup>17</sup> (Starling, 2013)
- CT myelogram when meets above guidelines and MRI is contraindicated or for surgical planning
- Post-procedure (discogram) CT

---

## BACKGROUND

Computed tomography is used for the evaluation, assessment of severity, and follow-up of diseases of the spine. Its use in the thoracic spine is limited, however, due to the lack of epidural fat in this part of the body. CT myelography improves the contrast severity of CT, but it is also invasive. CT may be used for conditions, e.g., degenerative changes, infection, and immune suppression, when magnetic resonance imaging (MRI) is contraindicated. It may also be used in the evaluation of tumors, cancer, or metastasis in the thoracic spine, and it may be used for preoperative and post-surgical evaluations. CT obtains images from different angles and uses computer processing to show a cross-section of body tissues and organs. CT is fast and is often performed in acute settings. It provides good visualization of cortical bone.

## OVERVIEW OVERVIEW

~~Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset <40). It is associated with any of the following<sup>60-63</sup> (Akgul, 2011; Bennett, 2010; Østergaard, 2012; Seiper, 2014):~~

- ~~Sedimentation rate and/or C reactive protein (not an essential criteria)~~
- ~~HLA B27 (not an essential criteria)~~
- ~~Non-diagnostic or indeterminate x-ray~~



- ~~Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease~~

**\*Conservative Therapy:** This should include a multimodality approach consisting of a **combination of active and inactive components**. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician supervised home exercise program\*\*, regular Osteopathic Manipulative medicine treatments or chiropractic care when considered safe and appropriate.

**\*\*Home Exercise Program (HEP)/Therapy**—the following elements are required to meet guidelines for completion of conservative therapy<sup>4,11</sup> (ACR, 2015; Last, 2009):-

- ~~Information provided on exercise prescription/plan; AND~~
- ~~Follow up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6 week period), or inability to complete HEP due to physical reason i.e., increased pain, inability to physically perform exercises. (Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).~~
- ~~Dates and duration of failed PT, physician supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.~~

**Table 1: Gait and spine imaging<sup>60-65‡</sup>**

Gait	Characteristic	Work up/Imaging
Hemiparetic	Spastic unilateral, circumduction	Brain and/or, Cervical spine imaging based on associated symptoms
Diplegic	Spastic bilateral, circumduction	Brain, Cervical and Thoracic Spine imaging
Myelopathic	Wide based, stiff, unsteady	Cervical and/or Thoracic spine MRI based on associated symptoms
Ataxic	Broad based, clumsy, staggering, lack of coordination, usually also with limb ataxia	Brain imaging
Apraxic	Magnetic, shuffling, difficulty initiating	Brain imaging
Parkinsonian	Stooped, small steps, rigid, turning en bloc, decreased arm swing	Brain Imaging

Choreiform	Irregular, jerky, involuntary movements	Medication review, consider brain imaging as per movement disorder Brain MR guidelines
Sensory ataxic	Cautious, stomping, worsening without visual input (ie + Romberg)	EMG, blood work, consider spinal (cervical or thoracic cord imaging) imaging based on EMG
Neurogenic	Steppage, dragging of toes	<ul style="list-style-type: none"> <li>• <u>EMG initial testing;</u></li> <li>• <u>BUT if there is a foot drop, lumbar spine MRI is appropriate without EMG</u></li> <li>• <u>Pelvis MR if there is evidence of plexopathy</u> <del>EMG à foot drop</del></li> <li>• <del>Lumbar spine MRI</del></li> <li>• <del>Pelvis MR appropriate evidence of plexopathy</del></li> </ul>
Vestibular	Insecure, veer to one side, worse when eyes closed, vertigo	Consider Brain/IAC MRI as per GL

(\*References: Chhetri, 2014; Clinch, 2021; Gait, 2021; Haynes, 2018; Marshall, 2012; Pirker, 2017)

Ankylosing Spondylitis/Spondyloarthropathies is a cause of back or sacroiliac pain of insidious onset (usually > 3 month), associated with morning stiffness not relieved with rest (usually age at onset <40). It is associated with any of the following<sup>66-69</sup>:

- Sedimentation rate and/or C-reactive protein (not an essential criteria)
- HLA B27 (not an essential criteria)
- Non-diagnostic or indeterminate x-ray
- Personal or family history of sacroilitis, peripheral inflammatory arthritis, and/or inflammatory bowel disease

\*Conservative Therapy – This should include a multimodality approach consisting of a combination of active and inactive components. Inactive components, such as rest, ice, heat, modified activities, medical devices, acupuncture and/or stimulators, medications, injections (epidural, facet, bursal, and/or joint, not including trigger point), and diathermy can be utilized. Active modalities may consist of physical therapy, a physician-supervised home exercise program\*\*, regular Osteopathic Manipulative medicine treatments or chiropractic care when considered safe and appropriate.

\*\*Home Exercise Program - (HEP)/Therapy – the following elements are required to meet guidelines for completion of conservative therapy<sup>4, 11</sup>:

- Information provided on exercise prescription/plan; AND
- Follow-up with member with documentation provided regarding lack of improvement (failed) after completion of HEP (after suitable 6-week period), or inability to complete HEP due to physical reason- i.e., increased pain, inability to physically perform exercises.

(Patient inconvenience or noncompliance without explanation does not constitute “inability to complete” HEP).

- Dates and duration of failed PT, physician-supervised HEP, or chiropractic treatment should be documented in the original office notes or an addendum to the notes.

**Table 2: CT and Cutaneous Stigmata<sup>79</sup> (Dias, 2015)**

<b>Risk Stratification for Various Cutaneous Markers</b>		
<u>High Risk</u>	<u>Intermediate Risk</u>	<u>Low Risk</u>
<ul style="list-style-type: none"> <li>• <del>Hypertrichosis</del></li> <li>• <del>Infantile hemangioma</del></li> <li>• <del>Artretic meningocele</del></li> <li>• <del>DST</del></li> <li>• <del>Subcutaneous lipoma</del></li> <li>• <del>Caudal appendage</del></li> <li>• <del>Segmental hemangiomas in association with LUMBAR<sup>‡</sup> syndrome</del></li> </ul>	<ul style="list-style-type: none"> <li>• <del>Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined or PWS when darker red and well-defined)</del></li> </ul>	<ul style="list-style-type: none"> <li>• <del>Coccygeal dimple</del></li> <li>• <del>Light hair</del></li> <li>• <del>Isolated café au lait spots</del></li> <li>• <del>Mongolian spots</del></li> <li>• <del>Hypo- and hypermelanotic macules or papules</del></li> <li>• <del>Deviated or forked gluteal cleft</del></li> <li>• <del>Nonmidline lesions</del></li> </ul>
<sup>‡</sup> LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.		

**CT and Fracture of the Lumbar Spine** – CT scans of the lumbar spine generate high-resolution spinal images; this and the absence of superimposed structures allow accurate diagnosis of lumbar fractures.

**CT and Radiculopathy** – Lumbar radiculopathy is caused by compression of a nerve root and/or inflammation that has progressed enough to cause neurologic symptoms, e.g., numbness, tingling, and weakness in leg muscles. These are warning signs of a serious medical condition ~~which~~ **that** needs medical attention. Multidetector CT may be performed to rule out or localize lumbar disk herniation before surgical intervention, when MRI is contraindicated. Radiation dose should be kept as low as possible in young individuals undergoing CT of the lumbar spine.

**CT and Infection of the spine** – Infection of the spine is not easy to differentiate from other spinal disorders, e.g., degenerative disease, spinal neoplasms, and non-infective inflammatory lesions. Infections may affect different parts of the spine, e.g., vertebrae, intervertebral discs, and paraspinal tissues. Imaging is important to obtain to early diagnose and treat ~~so as to~~ **to** avoid permanent neurology deficits. When MRI is contraindicated, CT may be used to evaluate infections of the spine.

**CT and Degenerative Disease of the Lumbar Spine** – Stenosis of the lumbar canal may result from degenerative changes of the discs, ligaments and facet joints surrounding the lumbar canal. Compression of the microvasculature of the bundle of nerve roots in the lumbosacral

spine may lead to significant effects on the cauda equina. This is a surgical emergency, and CT may be performed to help assess the problem when MRI is contraindicated or inappropriate. CT scans can provide visualization of the vertebral canal and may demonstrate encroachment of the canal by osteophytes, facets, pedicles, or hypertrophied lamina.

### Infection, Abscess, or Inflammatory disease

- Most common site is the lumbar spine (58%), followed by the thoracic spine (30%) and the cervical spine (11%)<sup>70</sup> ~~(Graeber, 2019)~~
- High risk populations (indwelling hardware, history of endocarditis, IVDA, recent procedures) with appropriate signs/symptoms

**CT and Low Back Pain** – Low back pain by itself is a self-limited condition which does not warrant any imaging studies. One of the “red flags” signifying a more complicated status is focal neurologic deficit with progressive or disabling symptoms. When magnetic resonance imaging (MRI) is contraindicated, CT of the lumbar spine with or without contrast is indicated for low back pain accompanied by a “red flag” symptom. Myelography combined with post-myelography CT is accurate in diagnosing disc herniation and may be useful in surgical planning. CT may be indicated when MRI is contraindicated, and chronic back pain unresponsive to conservative treatment; and unsuccessful physical therapy/home exercise program.

**Table 2: CT and Cutaneous Stigmata**<sup>71</sup>

<b>Risk Stratification for Various Cutaneous Markers</b>		
<b>High Risk</b>	<b>Intermediate Risk</b>	<b>Low Risk</b>
<ul style="list-style-type: none"> <li>• <u>Hypertrichosis</u></li> <li>• <u>Infantile hemangioma</u></li> <li>• <u>Atretic meningocele</u></li> <li>• <u>DST</u></li> <li>• <u>Subcutaneous lipoma</u></li> <li>• <u>Caudal appendage</u></li> <li>• <u>Segmental hemangiomas in association with LUMBAR<sup>‡</sup> syndrome</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Capillary malformations (also referred to as NFS or salmon patch when pink and poorly defined or PWS when darker red and well-defined)</u></li> </ul>	<ul style="list-style-type: none"> <li>• <u>Coccygeal dimple</u></li> <li>• <u>Light hair</u></li> <li>• <u>Isolated café au lait spots</u></li> <li>• <u>Mongolian spots</u></li> <li>• <u>Hypo- and hypermelanotic macules or papules</u></li> <li>• <u>Deviated or forked gluteal cleft</u></li> <li>• <u>Nonmidline lesions</u></li> </ul>
<sup>‡</sup> LUMBAR, lower body hemangioma and other cutaneous defects, urogenital abnormalities, ulcerations, myelopathy, bony defects, anorectal malformations, arterial anomalies, and renal anomalies.		

**Tethered spinal cord syndrome** — a neurological disorder caused by tissue attachments that limit the movement of the spinal cord within the spinal column. Although this condition is rare, it can continue undiagnosed into adulthood. The primary cause is myelomeningocele and lipomyelomeningocele; the following are other causes that vary in severity of symptoms and treatment.

- Dermal sinus tract (a rare congenital deformity)
- Diastematomyelia (split spinal cord)
- Lipoma
- Tumor
- Thickened/tight filum terminale
- History of spine trauma/surgery
- Arnold-Chiari Malformation

**Sacral Dimples** — Simple midline dimples are the most commonly encountered dorsal cutaneous stigmata in neonates and indicate low risk for spinal dysraphism. Only atypical dimples are associated with a high risk for spinal dysraphism, particularly those that are large (>5 mm), high on the back (>2.5 cm from the anus), or appear in combination with other lesions (~~D'Alessandro, 2009~~).<sup>72</sup> High-risk cutaneous stigmata in neonates include hemangiomas, upraised lesions (i.e., masses, tails, and hairy patches), and multiple cutaneous stigmata ([Table 2](#)).

**Spina Bifida Occulta**<sup>73</sup> (~~AANS, 2020~~)

- Called the hidden spina bifida, as the spinal cord and the nerves are usually normal and there is no opening on the skin on the back—
- This subtype occurs in about 12% of the population, and the majority of people are not aware that they have spina bifida occulta, unless it is discovered on an x-ray performed for an unrelated reason.
- Approximately 1 in 1,000 individuals can have an occult structural finding that leads to neurological deficits or disabilities as bowel or bladder dysfunction, back pain, leg weakness or scoliosis.

**Back Pain with Cancer— History** — Radiographic (x-ray) examination should be performed in cases of back pain when a patient has a cancer history. This can make a diagnosis in many cases. This may occasionally allow for selection of bone scan in lieu of MRI in some cases. When radiographs do not answer the clinical question, then MRI may be appropriate after a consideration of conservative care.

“Neoplasms causing VCF (vertebral compression fractures) include: primary bone neoplasms, such as hemangioma or giant cell tumors, and tumor-like conditions causing bony and cellular remodeling, such as aneurysmal bone cysts, or Paget’s disease (osteitis deformans); infiltrative neoplasms, including and not limited to multiple myeloma and lymphoma, and metastatic neoplasms (~~ACR, 2018~~).”<sup>22</sup>

Most common spine metastasis involving primary metastasis originate from the following tumors in descending order: breast (21%), lung (19%), prostate (7.5%), renal (5%), gastrointestinal (4.5%), and thyroid (2.5%). While all tumor can seed to the spine, the cancers mentioned above metastasize to the spinal column early in the disease process ~~(Ziu, 2019)~~.<sup>37</sup>

#### **CT ~~MYELOGRAM~~ Myelogram –**

Myelography is the instillation of intrathecal contrast media under fluoroscopy. Patients are then imaged with CT to evaluate for spinal canal pathology. Although this technique has diminished greatly due to the advent of MRI due to its non-invasiveness and superior soft-tissue contrast, myelography is still a useful technique for conventional indications, such as spinal stenosis, when MRI is contraindicated or nondiagnostic, brachial plexus injury in neonates, radiation therapy treatment planning, and cerebrospinal fluid (CSF) leak.

#### **~~CAUDA EQUINA SYNDROME~~ Cauda Equina Syndrome**

- Symptoms include severe back pain or sciatica along with one or more of the following:
  - Saddle anesthesia - loss of sensation restricted to the area of the buttocks, perineum and inner surfaces of the thighs (areas that would sit on a saddle).
  - Recent bladder/bowel dysfunction ~~(as listed above)~~
  - Achilles reflex absent on both sides
  - Sexual dysfunction that can come on suddenly
  - Absent anal reflex and bulbocavernosus reflex
- This is a “Red Flag” situation and Lumbar Spine MRI is approvable.

#### **Drop Metastases<sup>74</sup> –**

Drop metastases are intradural extramedullary spinal metastases that arise from intracranial lesions. Common examples of intracranial neoplasms that result in drop metastases include pineal tumors, ependymomas, medulloblastomas, germinomas, primitive neuroectodermal tumors (PNET), glioblastomas multiform, anaplastic astrocytomas, oligodendrogliomas and less commonly choroid plexus neoplasms and teratomas.

#### **Leptomeningeal Carcinomatosis<sup>75</sup> –**

Leptomeningeal carcinomatosis is a complication of cancer in which cancerous cells spread to the membranes (meninges) that covers the brain and spinal cord. The most common solid tumors that involve the leptomeninges are breast, lung, ~~and~~ melanoma, gastrointestinal, and primary central nervous system tumors.

#### **POLICY HISTORY**

Date	Summary
<u>March 2022</u>	<u>Added</u> <ul style="list-style-type: none"> <li>• <u>Combination request for overlapping body part statement</u></li> <li>• <u>Clarified muscle weakness no related to plexopathy or peripheral neuropathy</u></li> </ul>



	<ul style="list-style-type: none"> <li>• <u>Clarified bowel and bladder dysfunction – not related to an inherent bowel or bladder problem</u></li> <li>• <u>Descriptions for tethered cord</u></li> <li>• <u>Clarified CT myelogram section</u></li> <li>• <u>Background section of Drop Metastases</u></li> <li>• <u>Background section of Leptomeningeal Carcinomatosis</u></li> <li>• <u>Clarified toe walking in pediatric patient</u></li> <li>• <u>Added section on neuroinflammatory conditions</u></li> </ul> <p><u>Removed</u></p> <ul style="list-style-type: none"> <li>• <u>Removed from combination section syrinx and syringomyelia and added subsection for cervical and thoracic spine section</u></li> <li>— <u>Removed pediatric back pain from the total spine combination section</u></li> </ul>
April 2021	<ul style="list-style-type: none"> <li>• Added/modified <ul style="list-style-type: none"> <li>○ Modified section on neurological deficits</li> <li>○ Back pain in a child added/modified red flags</li> <li>○ Gait table in background</li> <li>○ Post-surgical modified/clarified surgical criteria for combination exams and surgeon preference for exam type</li> <li>○ Removed myelopathy combination studies</li> <li>○ Updated/added MS Criteria <ul style="list-style-type: none"> <li>▪ Combination section for initial imaging and follow up</li> <li>▪ Added pediatric MS</li> </ul> </li> <li>○ Modified known tumor imaging into primary and metastatic disease</li> <li>○ Added toe walking for pediatric patients</li> <li>○ Modified Combination exam wording</li> <li>○ Added anorectal malformations</li> </ul> </li> </ul>
May 2020	<ul style="list-style-type: none"> <li>• For evaluation of neurologic deficits added new deficits</li> <li>• Added ankylosing spondylitis for evaluation of trauma/acute injury</li> <li>• Added Osteopathic Manipulative medicine to conservative care therapy</li> <li>• Modified Initial imaging of new or increasing non-traumatic back pain or radiculopathy or back pain that occurs at night and wakes the patient from sleep with known active cancer and a tumor that tends to metastasize to the spine</li> <li>• Modified Pars fracture to not seen on radiograph and imaging would change management</li> </ul>

	<ul style="list-style-type: none"> <li>• Combined the acute and chronic back pain sections</li> <li>• Added spina bifida occulta to background section</li> </ul>
June 2019	<ul style="list-style-type: none"> <li>• Added CT myelogram</li> <li>• Added new or worsening objective neuro deficits for chronic and acute back pain</li> <li>• Added last 6 months for allowable post op follow up period and removed EMG comment</li> <li>• Added section on pars defect</li> <li>• Added section on compression fractures</li> <li>• In other indications removed myelogram since covered previously</li> <li>• Added congenital anomalies</li> <li>• Added sacral dimple and scoliosis</li> <li>• Added red flags specifically for peds back pain and pain related to malignancy, infection, inflammation</li> <li>• Added CSF leak indication</li> <li>• For combination studies C/T/L added drop metastasis, tethered cord, Arnold Chiari</li> </ul>

## REFERENCES

- Akgul, O, Ozgoemen S. Classification criteria for spondyloarthropathies. *World J Orthop*. December 18, 2011; 2(12):107-115. doi: 10.5312/wjo.v2.i12.07. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3302034/>.
- Alexandru D. Evaluation and management of vertebral compression fractures. *Perm J*. Published online October 30, 2012;46-51. doi:10.7812/TPP/12-037.
- American Academy of Family Physicians (AAFP). Fifteen Things Physicians and Patients Should Question. Choosing Wisely®. <http://www.choosingwisely.org/societies/american-academy-of-family-physicians/>. Published April 4, 2012.
- American Association of Neurological Surgeons (AANS). Spina Bifida. 2020.
- American Association of Neurological Surgeons (AANS). Tethered Spinal Cord Syndrome. <http://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-SpinalCord-Syndrome>. 2019.
- American Association of Neurological Surgeons and Congress of Neurological Surgeons (AANSCNS). Five Things Physicians and Patients Should Question. Choosing Wisely®. <http://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>. Published June 24, 2014.
- American Chiropractic Association (ACA). Five Things Physicians and Patients Should Question. Choosing Wisely®. <http://www.choosingwisely.org/societies/american-chiropractic-association/>. Published August 15, 2017.
- American College of Emergency Physicians (ACEP). Ten Things Physicians and Patients Should Question. Choosing Wisely®. <http://www.choosingwisely.org/societies/american-college-of-emergency-physicians/>. Published October 27, 2014.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. <http://www.acr.org/Quality-Safety/Appropriateness-Criteria/Diagnostic>. Published 2015.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. Back Pain—Child. <https://acsearch.acr.org/docs/3099011/Narrative/>. Published 2016.
- American College of Radiology (ACR). ACR Appropriateness Criteria®. Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. <https://acsearch.acr.org/docs/3094107/Narrative/>. Revised 2021.
- Bennett AN, Marzo-Ortega H, Rehman A, et al. The evidence for whole spine MRI in the assessment of axial spondyloarthritis. *Rheumatology*. March 2010; 49(3):426-432.

~~<https://doi.org/10.1093/rheumatology/kep427>.~~  
~~<https://academic.oup.com/rheumatology/article/49/3/426/1787410>.~~

~~Berberi EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. 2015 Sep 15; 61(6):e26–e46.~~

~~Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. 2007;76(11):1669–1676.~~

~~Bond A, Manian FA. Spinal epidural abscess: A review with special emphasis on earlier diagnosis. *Biomed Res Int*. 2016; 2016:1614328.~~

~~Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. 2014;14(4):242–251. doi:10.1136/practneurol-2013-000764.~~

~~Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: A joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. October 2, 2007; 147(7):478–491.  
<http://annals.org/article.aspx?volume=147&issue=7&page=478>.~~

~~Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. *BMJ Best Practice*. Published February 23, 2021. Accessed July 14, 2021. <https://bestpractice.bmj.com/topics/en-us/709>.~~

~~Cohen E, Stuecker RD. Magnetic resonance imaging in diagnosis and follow-up of impending spondylolysis in children and adolescents: Early treatment may prevent pars defects. *J Pediatr Orthop B*. 2005; 14(2):63–67.~~

~~D' Alessandro D. Does This Sacral Dimple Need to be Evaluated? *PediatricEducation.org*™. Iowa City, IA: July 20, 2009. <https://pediatriceducation.org/2009/07/20/does-this-sacral-dimple-need-to-be-evaluated/>. Retrieved March 29, 2018.~~

~~Davis PC, Wippold FJ, Brunberg JA, et al. ACR appropriateness criteria on low back pain. *J Am Coll Radiol*. 2008; 6:401–407. doi: 10.1016/j.jacr.2009.02.008.~~

~~Dias M, Partington M. Congenital brain and spinal cord malformations and their associated cutaneous markers. *Pediatrics*. 2015; 136(4):e1105–19.~~

~~Duz B, Gocmen S, Secer HI, et al. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008; 31(3):272–278. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2565560/>. Retrieved March 29, 2018.~~

Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. 2006;26(3):353-357. doi:10.1097/01.bpo.0000214928.25809.f9.

Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaik S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. 2013;206(6):987-993; discussion 993-994. doi:10.1016/j.amjsurg.2013.08.021.

Gait abnormalities. Stanford Medicine 25. Published 2021. Accessed July 14, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>.

Graeber A, Cecava ND. Vertebral Osteomyelitis. [Updated 2019 Jun 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan.

Grams AE, Gempt J, Förschler A. Comparison of spinal anatomy between 3-Tesla MRI and CT-myelography under healthy and pathological conditions. *Surg Radiol Anat*. 2010; 32(6):581-585.

Haynes KB, Wimberly RL, VanPelt JM, Jo C H, Riccio AI, Delgado MR. Toe walking: A neurological perspective after referral from pediatric orthopaedic surgeons. *Journal of Pediatric Orthopaedics*. 2018;38(3):152-156. doi:10.1097/BPO.0000000000001115.

Hertzler DA, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: A review of the literature from embryology to adult presentation. *Neurosurg Focus*. 2010;29(1):E1. doi:10.3171/2010.3.FOCUS1079.

Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *JAMA*. 2015; 313(11):1143-1153. doi: 10.1001/jama.2015.1871.

Kim SM, Chang HK, Lee MJ, et al. Spinal dysraphism with anorectal malformation: Lumbosacral magnetic resonance imaging evaluation of 120 patients. *Journal of Pediatric Surgery*. 2010;45(4):769-776. doi:10.1016/j.jpedsurg.2009.10.094.

Kim YS, Han IH, Lee IS, et al. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. August 2012; 52(2):126-132. doi: 10.3340/jkns.2012.52.2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3467370/>. Retrieved March 29, 2018.

Kobayashi A, Kobayashi T, Kato K, et al. Diagnosis of radiographically occult lumbar spondylolysis in young athletes by magnetic resonance imaging. *Am J Sports Med*. 2013; 41(1):169-176.

~~Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. Skeletal Radiol. 2008 Sep;37(9):813-9. doi:10.1007/s00256-008-0484-x. Epub 2008 Apr 18.~~

~~Last AR, Hulbert K. Chronic low back pain: Evaluation and management. Am Fam Physician. 2009; 79(12):1067-74.~~

~~Lerner S, Hartmann S, Barbagallo GMV, et al. Management of spinal infection: A review of the literature. Acta Neurochir (Wien). 2018; 160(3): 487-496.~~

~~Marshall FJ. Approach to the elderly patient with gait disturbance. Neurol Clin Pract. 2012;2(2):103-111. doi:10.1212/CPJ.0b013e31825a7823.~~

~~Matesan M, Behnia F, Bermo M, et al. SPECT/CT bone scintigraphy to evaluate low back pain in young athletes: common and uncommon etiologies. J Orthop Surg Res. 2016; 11:76.~~

~~McDonald MA, Kirsch CFE, Amin BY, et al. ACR Appropriateness Criteria® cervical neck pain or cervical radiculopathy. J Am Coll Radiol. 2019;16(5S):S57-S76. doi:10.1016/j.jacr.2019.02.023.~~

~~Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. Surg Neurol. July 2009; 72(1):20-35. <http://europepmc.org/abstract/med/19559924>.~~

~~Morimoto K, Takemoto O, Wakayama A. Tethered cord associated with anorectal malformation. Pediatr Neurosurg. 2003;38(2):79-82. doi:10.1159/000068048.~~

~~Morita M, Miyauchi A, Okuda S, et al. Comparison between MRI and myelography in lumbar spinal canal stenosis for the decision of levels of decompression surgery. J Spinal Disord Tech. 2011; 24(1):31-36.~~

~~Naganawa T, Miyamoto K, Ogura H, et al. Comparison of magnetic resonance imaging and computed tomogram-myelography for evaluation of cross-sections of cervical spinal morphology. Spine. 2011; 36(1):50-56.~~

~~National Institute of Neurological Disorder and Stroke (NINDS). Tethered Spinal Cord Syndrome Information Page. [http://www.ninds.nih.gov/disorders/tethered\\_cord/tethered\\_cord.htm](http://www.ninds.nih.gov/disorders/tethered_cord/tethered_cord.htm). Published 2011.~~

~~North American Spine Society (NASS). Five Things Physicians and Patients Should Question: Choosing Wisely®. <http://www.choosingwisely.org/societies/north-american-spine-society/>. Published October 9, 2013.~~

~~North American Spine Society (NASS). Evidence-based Clinical Guidelines for Multidisciplinary Spine Care. Diagnosis and Treatment of Lumbar Disc Herniation with Radiculopathy. 2012.~~

<https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/LumbarDiscHerniation.pdf>

Ostergaard M, Lambert RG. Imaging in ankylosing spondylitis. *Ther Adv Musculoskelet Dis*. August 2012; 4(4):301-311. doi: 10.1177/1759720X11436240. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3403247/>. Retrieved March 29, 2018.

Ozdoba C, Gralla J, Rieke A, et al. Myelography in the age of MRI: Why we do it, and how we do it. *Radiol Res Prac*. 2011; Article ID 329017.

Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. 2010;34(4):543-546. doi:10.1007/s00264-009-0817-y.

Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. 2017;129(3-4):81-95. doi:10.1007/s00508-016-1096-4.

Pomerantz SR. Myelography: modern technique and indications. *Handb Clin Neurol*. 2016; 135:193-208.

Radic JAE, Cochrane DD. Choosing wisely canada: pediatric neurosurgery recommendations. *Paediatr Child Health*. 2018;23(6):383-387. doi:10.1093/pch/pxy012.

Rao D, Scuderi G, Scuderi C, Grewal R, et al. The use of imaging in management of patients with low back pain. *J Clin Imaging Sci*. 2018 Aug 24; 8:30.

Rush JK, Astur N, Scott S, et al. Use of magnetic resonance imaging in the evaluation of spondylolysis. *J Pediatr Orthop*. 2015 Apr-May; 35(3):271-5.

Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011; 2011:769753.

Sieper J, Rudwaleit M, Baraliakos X, et al. The assessment of SpondyloArthritis international Society (ASAS) handbook: a guide to assess spondyloarthritis. *Ann Rheum Dis*. June 2009; 68 Suppl 2:ii1-44. Retrieved March 29, 2018.

Starling A, Hernandez F, Hoxworth JM, et al. Sensitivity of MRI of the spine compared with CT myelography in orthostatic headache with CSF leak. *Neurology*. 2013;81(20):1789-1792. doi:10.1212/01.wnl.0000435555.13695.22.

Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJL, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr*. 2011;8(2):205-213. doi:10.3171/2011.5.PEDS1121.



~~Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr*. June 2015; 15(6):607-611. Retrieved March 29, 2018.~~

~~Trenga AP, Singla A, Feger MA, et al. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. August 2016; 10(4):343-352. doi: 10.1007/s11832-016-0752-6. Retrieved March 29, 2018.~~

~~Willen J, Wessberg PJ, Danielsson B. Surgical results in hidden lumbar spinal stenosis detected by axial loaded computed tomography and magnetic resonance imaging: An outcome study. *Spine*. 2008; 33(4):E109-E115. doi: 10.1097/BRS.0b013e318163f9ab.~~

~~Ziu E, Viswanathan VK, Mesfin FB. Cancer, Spinal Metastasis. [Updated 2020 Mar 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK441950/>.~~

~~Zywicke HA, Rozzelle CJ. Sacral dimples. *Pediatr Rev*. 2011;32(3):109-113; quiz 114, 151. doi:10.1542/pir.32-3-109.~~

**Reviewed / Approved by NIA Clinical Guideline Committee**

## **GENERAL INFORMATION**

~~It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.~~

**Disclaimer:** Magellan Healthcare service authorization policies do not constitute medical advice and are not intended to govern or otherwise influence the practice of medicine. These policies are not meant to supplant your normal procedures, evaluation, diagnosis, treatment and/or care plans for your patients. Your professional judgement must be exercised and followed in all respects with regard to the treatment and care of your patients. These policies apply to all Magellan Healthcare subsidiaries including, but not limited to, National Imaging Associates (“Magellan”). The policies constitute only the reimbursement and coverage guidelines of Magellan. Coverage for services varies for individual members in accordance with the terms and conditions of applicable Certificates of Coverage, Summary Plan Descriptions, or contracts with governing regulatory agencies. Magellan reserves the right to review and update the guidelines at its sole discretion. Notice of such changes, if necessary, shall be provided in accordance with the terms and conditions of provider agreements and any applicable laws or regulations.

- ~~1. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *Jama*. Mar 17 2015;313(11):1143-53. doi:10.1001/jama.2015.1871~~
- ~~2. Last AP, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician*. Jun 15 2009;79(12):1067-74.~~
- ~~3. North American Spine Society. Five things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021. <https://www.choosingwisely.org/societies/north-american-spine-society/>~~
- ~~4. American Association of Neurological Surgeons, Congress of Neurological Surgeons. Five things physicians and patients should question: Don’t obtain imaging (plain radiographs, magnetic resonance imaging, computed tomography [CT], or other advanced imaging) of the spine in patients with non-specific acute low back pain and without red flags. Choosing Wisely Initiative ABIM Foundation. Updated 2020. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>~~
- ~~5. American Chiropractic Association. Five things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated July 12, 2021. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-chiropractic-association/>~~

6. American College of Emergency Physicians. Ten things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2018. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-college-of-emergency-physicians/>
7. American Academy of Family Physicians. Twenty things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-academy-of-family-physicians/>
8. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. Oct 2 2007;147(7):478-91. doi:10.7326/0003-4819-147-7-200710020-00006
9. American College of Radiology. ACR Appropriateness Criteria® Low Back Pain. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69483/Narrative/>
10. North American Spine Society. Five things physicians and patients should question: Don't use electromyography (EMG) and nerve conduction studies (NCS) to determine the cause of axial lumbar, thoracic or cervical spine pain. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>
11. American College of Radiology. ACR Appropriateness Criteria® Back Pain—Child. American College of Radiology (ACR). Updated 2016. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3099011/Narrative/>
12. Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. Dec 1 2007;76(11):1669-76.
13. Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. May-Jun 2006;26(3):353-7. doi:10.1097/01.bpo.0000214928.25809.f9
14. Rao D, Scuderi G, Scuderi C, Grewal R, Sandhu SJ. The Use of Imaging in Management of Patients with Low Back Pain. *J Clin Imaging Sci*. 2018;8:30. doi:10.4103/jcis.JCIS\_16\_18
15. Starling A, Hernandez F, Hoxworth JM, et al. Sensitivity of MRI of the spine compared with CT myelography in orthostatic headache with CSF leak. *Neurology*. Nov 12 2013;81(20):1789-92. doi:10.1212/01.wnl.0000435555.13695.22
16. Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaike S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. Dec 2013;206(6):987-93; discussion 993-4. doi:10.1016/j.amjsurg.2013.08.021
17. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Trauma American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69359/Narrative/>
18. Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol*. Sep 2008;37(9):813-9. doi:10.1007/s00256-008-0484-x
19. American College of Radiology. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/70545/Narrative/>
20. Alexandru D, So W. Evaluation and management of vertebral compression fractures. *Perm J*. Fall 2012;16(4):46-51. doi:10.7812/tpp/12-037

21. Morita M, Miyauchi A, Okuda S, Oda T, Iwasaki M. Comparison between MRI and myelography in lumbar spinal canal stenosis for the decision of levels of decompression surgery. *J Spinal Disord Tech*. Feb 2011;24(1):31-6. doi:10.1097/BSD.0b013e3181d4c993
22. Naganawa T, Miyamoto K, Ogura H, Suzuki N, Shimizu K. Comparison of magnetic resonance imaging and computed tomogram myelography for evaluation of cross sections of cervical spinal morphology. *Spine (Phila Pa 1976)*. Jan 1 2011;36(1):50-6. doi:10.1097/BRS.0b013e3181cb469c
23. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Lumbar Disc Herniation with Radiculopathy. North American Spine Society (NASS). Updated 2012. Accessed November 11, 2021. <https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/LumbarDiscHerniation.pdf>
24. Ozdoba C, Gralla J, Rieke A, Binggeli R, Schroth G. Myelography in the Age of MRI: Why We Do It, and How We Do It. *Radiol Res Pract*. 2011;2011:329017. doi:10.1155/2011/329017
25. Grams AE, Gempt J, Förschler A. Comparison of spinal anatomy between 3-Tesla MRI and CT-myelography under healthy and pathological conditions. *Surg Radiol Anat*. Jul 2010;32(6):581-5. doi:10.1007/s00276-009-0601-0
26. Cohen E, Stuecker RD. Magnetic resonance imaging in diagnosis and follow up of impending spondylolysis in children and adolescents: early treatment may prevent pars defects. *J Pediatr Orthop B*. Mar 2005;14(2):63-7. doi:10.1097/01202412-200503000-00001
27. Kobayashi A, Kobayashi T, Kato K, Higuchi H, Takagishi K. Diagnosis of radiographically occult lumbar spondylolysis in young athletes by magnetic resonance imaging. *Am J Sports Med*. Jan 2013;41(1):169-76. doi:10.1177/0363546512464946
28. Rush JK, Astur N, Scott S, Kelly DM, Sawyer JR, Warner WC, Jr. Use of magnetic resonance imaging in the evaluation of spondylolysis. *J Pediatr Orthop*. Apr-May 2015;35(3):271-5. doi:10.1097/bpo.0000000000000244
29. Matesan M, Behnia F, Bermo M, Vesselle H. SPECT/CT bone scintigraphy to evaluate low back pain in young athletes: common and uncommon etiologies. *J Orthop Surg Res*. Jul 2016;11(1):76. doi:10.1186/s13018-016-0402-1
30. Kim YS, Han IH, Lee IS, Lee JS, Choi BK. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. 2012;52(2):126-132. doi:10.3340/jkns.2012.52.2.126
31. McDonald MA, Kirsch CFE, Amin BY, et al. ACR Appropriateness Criteria(®) Cervical Neck Pain or Cervical Radiculopathy. *J Am Coll Radiol*. May 2019;16(5s):S57-S76. doi:10.1016/j.jacr.2019.02.023
32. American College of Radiology. ACR Appropriateness Criteria® Cervical Neck Pain or Cervical Radiculopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69426/Narrative/>
33. Ziu E, Viswanathan VK, Mesfin FB. Spinal Metastasis. StatPearls Publishing. Updated August 27, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK441950/>
34. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Infection. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3148734/Narrative/>

35. Lener S, Hartmann S, Barbagallo GMV, Certo F, Thomé C, Tschugg A. Management of spinal infection: a review of the literature. *Acta Neurochir (Wien)*. Mar 2018;160(3):487-496. doi:10.1007/s00701-018-3467-2
36. Bond A, Manian FA. Spinal Epidural Abscess: A Review with Special Emphasis on Earlier Diagnosis. *Biomed Res Int*. 2016;2016:1614328. doi:10.1155/2016/1614328
37. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. Sep 15 2015;61(6):e26-46. doi:10.1093/cid/civ482
38. American College of Radiology. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3094107/Narrative/>
39. Zalatio O. Tethered Spinal Cord Syndrome. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 10, 2021. <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-Spinal-Cord-Syndrome>
40. Düz B, Goemen S, Secer Hİ, Basal S, Gönül E. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008;31(3):272-8. doi:10.1080/10790268.2008.11760722
41. Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. *Surg Neurol*. Jul 2009;72(1):20-35. doi:10.1016/j.surneu.2009.03.008
42. Morimoto K, Takemoto O, Wakayama A. Tethered cord associated with anorectal malformation. *Pediatr Neurosurg*. Feb 2003;38(2):79-82. doi:10.1159/000068048
43. Kim SM, Chang HK, Lee MJ, et al. Spinal dysraphism with anorectal malformation: lumbosacral magnetic resonance imaging evaluation of 120 patients. *J Pediatr Surg*. Apr 2010;45(4):769-76. doi:10.1016/j.jpedsurg.2009.10.094
44. Zywicke HA, Rozzelle CJ. Sacral dimples. *Pediatr Rev*. Mar 2011;32(3):109-13; quiz 114, 151. doi:10.1542/pir.32-3-109
45. American College of Radiology. ACR Appropriateness Criteria® Headache-Child. American College of Radiology. Updated 2017. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69439/Narrative/>
46. American College of Radiology. ACR Appropriateness Criteria® Headache. American College of Radiology. Updated 2019. Accessed November 1, 2021. <https://acsearch.acr.org/docs/69482/Narrative/>
47. American College of Radiology. ACR Appropriateness Criteria® Scoliosis-Child. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3101564/Narrative/>
48. Juvenile Scoliosis. Scoliosis Research Society (SRS). Updated 2021. Accessed November 10, 2021. <https://www.srs.org/professionals/online-education-and-resources/conditions-and-treatments/juvenile-scoliosis>
49. Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg-Pediatr*. Jun 2015;15(6):607-11. doi:10.3171/2014.11.Peds14135

50. Trenga AP, Singla A, Feger MA, Abel MF. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. Aug 2016;10(4):343–52. doi:10.1007/s11832-016-0752-6
51. Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. Apr 2010;34(4):543–6. doi:10.1007/s00264-009-0817-y
52. Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJ, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg-Pediatr*. Aug 2011;8(2):205–13. doi:10.3171/2011.5.Peds1121
53. Radic JAE, Cochrane DD. Choosing Wisely Canada: Pediatric Neurosurgery Recommendations. *Paediatr Child Health*. Sep 2018;23(6):383–387. doi:10.1093/pch/pxy012
54. Hertzler DA, 2nd, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: a review of the literature from embryology to adult presentation. *Neurosurg Focus*. Jul 2010;29(1):E1. doi:10.3171/2010.3.Focus1079
55. Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011;2011:769753. doi:10.1155/2011/769753
56. Sieper J, Rudwaleit M, Baraliakos X, et al. The Assessment of SpondyloArthritis international Society (ASAS) handbook: a guide to assess spondyloarthritis. *Ann Rheum Dis*. Jun 2009;68 Suppl 2:ii1–44. doi:10.1136/ard.2008.104018
57. Akgul O, Ozgoemen S. Classification criteria for spondyloarthropathies. *World J Orthop*. Dec 18 2011;2(12):107–15. doi:10.5312/wjo.v2.i12.07
58. Bennett AN, Marzo Ortega H, Rehman A, Emery P, McGonagle D. The evidence for whole-spine MRI in the assessment of axial spondyloarthropathy. *Rheumatology (Oxford)*. Mar 2010;49(3):426–32. doi:10.1093/rheumatology/kep427
59. Ostergaard M, Lambert RG. Imaging in ankylosing spondylitis. *Ther Adv Musculoskelet Dis*. Aug 2012;4(4):301–11. doi:10.1177/1759720x11436240
60. Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. Aug 2014;14(4):242–51. doi:10.1136/practneurol-2013-000764
61. Foster H, Drummond P, Jandial S, Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. *BMJ Best Practice*. Updated February 23, 2021. Accessed November 2, 2021. <https://bestpractice.bmj.com/topics/en-us/709>
62. Stanford Medicine. Gait Abnormalities. Stanford University. Updated 2021. Accessed November 2, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>
63. Haynes KB, Wimberly RL, VanPelt JM, Jo CH, Riccio AI, Delgado MR. Toe Walking: A Neurological Perspective After Referral From Pediatric Orthopaedic Surgeons. *J Pediatr Orthop*. Mar 2018;38(3):152–156. doi:10.1097/bpo.0000000000001115
64. Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. Jun 2012;2(2):103–111. doi:10.1212/CPJ.0b013e31825a7823
65. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. Feb 2017;129(3–4):81–95. doi:10.1007/s00508-016-1096-4
66. Dias M, Partington M. Congenital Brain and Spinal Cord Malformations and Their Associated Cutaneous Markers. *Pediatrics*. Oct 2015;136(4):e1105–19. doi:10.1542/peds.2015-2854



~~67. Graeber A, Cecava ND. Vertebral Osteomyelitis. StatPearls Publishing. Updated July 22, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK532256/>~~

~~68. D'Alessandro DM. Does This Sacral Dimple Need to be Evaluated? PediatricEducation.org™. Updated July 20, 2009. Accessed November 10, 2021. <https://pediatriceducation.org/2009/07/20/does-this-sacral-dimple-need-to-be-evaluated/>~~

~~69. Patel NT, Rizk EB, Simon SD. Spina Bifida. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 11, 2021. <https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Spina-Bifida>~~

1. Moore KR, Tsuruda JS, Dailey AT. The value of MR neurography for evaluating extraspinal neuropathic leg pain: a pictorial essay. *AJNR Am J Neuroradiol*. Apr 2001;22(4):786-94.
2. Dydyk AM, Hameed S. Lumbosacral Plexopathy. StatPearls Publishing Copyright © 2022, StatPearls Publishing LLC. Updated November 7, 2021. Accessed February 25, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK556030/>
3. Jarvik JG, Gold LS, Comstock BA, et al. Association of early imaging for back pain with clinical outcomes in older adults. *Jama*. Mar 17 2015;313(11):1143-53. doi:10.1001/jama.2015.1871
4. Last AR, Hulbert K. Chronic low back pain: evaluation and management. *Am Fam Physician*. Jun 15 2009;79(12):1067-74.
5. North American Spine Society. Five things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021. <https://www.choosingwisely.org/societies/north-american-spine-society/>
6. American Association of Neurological Surgeons, Congress of Neurological Surgeons. Five things physicians and patients should question: Don't obtain imaging (plain radiographs, magnetic resonance imaging, computed tomography [CT], or other advanced imaging) of the spine in patients with non-specific acute low back pain and without red flags. Choosing Wisely Initiative ABIM Foundation. Updated 2020. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/american-association-neurological-surgeons-imaging-for-nonspecific-acute-low-back-pain/>
7. American Chiropractic Association. Five things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated July 12, 2021. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-chiropractic-association/>
8. American College of Emergency Physicians. Ten things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2018. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-college-of-emergency-physicians/>
9. American Academy of Family Physicians. Twenty things physicians and patients should question. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 11, 2021. <https://www.choosingwisely.org/societies/american-academy-of-family-physicians/>
10. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. Oct 2 2007;147(7):478-91. doi:10.7326/0003-4819-147-7-200710020-00006
11. American College of Radiology. ACR Appropriateness Criteria® Low Back Pain. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69483/Narrative/>



12. North American Spine Society. Five things physicians and patients should question: Don't use electromyography (EMG) and nerve conduction studies (NCS) to determine the cause of axial lumbar, thoracic or cervical spine pain. Choosing Wisely Initiative ABIM Foundation. Updated 2021. Accessed November 9, 2021. <https://www.choosingwisely.org/clinician-lists/nass-emg-nerve-conduction-studies-to-determine-cause-of-spine-pain/>
13. American College of Radiology. ACR Appropriateness Criteria® Back Pain—Child. American College of Radiology (ACR). Updated 2016. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3099011/Narrative/>
14. Bernstein RM, Cozen H. Evaluation of back pain in children and adolescents. *Am Fam Physician*. Dec 1 2007;76(11):1669-76.
15. Feldman DS, Straight JJ, Badra MI, Mohaideen A, Madan SS. Evaluation of an algorithmic approach to pediatric back pain. *J Pediatr Orthop*. May-Jun 2006;26(3):353-7. doi:10.1097/01.bpo.0000214928.25809.f9
16. Rao D, Scuderi G, Scuderi C, Grewal R, Sandhu SJ. The Use of Imaging in Management of Patients with Low Back Pain. *J Clin Imaging Sci*. 2018;8:30. doi:10.4103/jcis.JCIS\_16\_18
17. Starling A, Hernandez F, Hoxworth JM, et al. Sensitivity of MRI of the spine compared with CT myelography in orthostatic headache with CSF leak. *Neurology*. Nov 12 2013;81(20):1789-92. doi:10.1212/01.wnl.0000435555.13695.22
18. Corona-Cedillo R, Saavedra-Navarrete MT, Espinoza-Garcia JJ, Mendoza-Aguilar AN, Ternovoy SK, Roldan-Valadez E. Imaging Assessment of the Postoperative Spine: An Updated Pictorial Review of Selected Complications. *Biomed Res Int*. 2021;2021:9940001. doi:10.1155/2021/9940001
19. Fisher BM, Cowles S, Matulich JR, Evanson BG, Vega D, Dissanaik S. Is magnetic resonance imaging in addition to a computed tomographic scan necessary to identify clinically significant cervical spine injuries in obtunded blunt trauma patients? *Am J Surg*. Dec 2013;206(6):987-93; discussion 993-4. doi:10.1016/j.amjsurg.2013.08.021
20. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Trauma American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69359/Narrative/>
21. Koivikko MP, Koskinen SK. MRI of cervical spine injuries complicating ankylosing spondylitis. *Skeletal Radiol*. Sep 2008;37(9):813-9. doi:10.1007/s00256-008-0484-x
22. American College of Radiology. ACR Appropriateness Criteria® Management of Vertebral Compression Fractures. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/70545/Narrative/>
23. Alexandru D, So W. Evaluation and management of vertebral compression fractures. *Perm J*. Fall 2012;16(4):46-51. doi:10.7812/tpp/12-037
24. Morita M, Miyauchi A, Okuda S, Oda T, Iwasaki M. Comparison between MRI and myelography in lumbar spinal canal stenosis for the decision of levels of decompression surgery. *J Spinal Disord Tech*. Feb 2011;24(1):31-6. doi:10.1097/BSD.0b013e3181d4c993
25. Naganawa T, Miyamoto K, Ogura H, Suzuki N, Shimizu K. Comparison of magnetic resonance imaging and computed tomogram-myelography for evaluation of cross sections of cervical spinal morphology. *Spine (Phila Pa 1976)*. Jan 1 2011;36(1):50-6. doi:10.1097/BRS.0b013e3181cb469c

26. Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care: Diagnosis and Treatment of Lumbar Disc Herniation with Radiculopathy. North American Spine Society (NASS). Updated 2012. Accessed November 11, 2021.  
<https://www.spine.org/Portals/0/Assets/Downloads/ResearchClinicalCare/Guidelines/LumbarDiscHerniation.pdf>
27. Ozdoba C, Gralla J, Rieke A, Binggeli R, Schroth G. Myelography in the Age of MRI: Why We Do It, and How We Do It. *Radiol Res Pract*. 2011;2011:329017. doi:10.1155/2011/329017
28. Grams AE, Gempt J, Förschler A. Comparison of spinal anatomy between 3-Tesla MRI and CT-myelography under healthy and pathological conditions. *Surg Radiol Anat*. Jul 2010;32(6):581-5. doi:10.1007/s00276-009-0601-0
29. Cohen E, Stuecker RD. Magnetic resonance imaging in diagnosis and follow-up of impending spondylolysis in children and adolescents: early treatment may prevent pars defects. *J Pediatr Orthop B*. Mar 2005;14(2):63-7. doi:10.1097/01202412-200503000-00001
30. Kobayashi A, Kobayashi T, Kato K, Higuchi H, Takagishi K. Diagnosis of radiographically occult lumbar spondylolysis in young athletes by magnetic resonance imaging. *Am J Sports Med*. Jan 2013;41(1):169-76. doi:10.1177/0363546512464946
31. Rush JK, Astur N, Scott S, Kelly DM, Sawyer JR, Warner WC, Jr. Use of magnetic resonance imaging in the evaluation of spondylolysis. *J Pediatr Orthop*. Apr-May 2015;35(3):271-5. doi:10.1097/bpo.0000000000000244
32. Matesan M, Behnia F, Bermo M, Vesselle H. SPECT/CT bone scintigraphy to evaluate low back pain in young athletes: common and uncommon etiologies. *J Orthop Surg Res*. Jul 7 2016;11(1):76. doi:10.1186/s13018-016-0402-1
33. Kim YS, Han IH, Lee IS, Lee JS, Choi BK. Imaging findings of solitary spinal bony lesions and the differential diagnosis of benign and malignant lesions. *J Korean Neurosurg Soc*. 2012;52(2):126-132. doi:10.3340/jkns.2012.52.2.126
34. McDonald MA, Kirsch CFE, Amin BY, et al. ACR Appropriateness Criteria(®) Cervical Neck Pain or Cervical Radiculopathy. *J Am Coll Radiol*. May 2019;16(5s):S57-s76. doi:10.1016/j.jacr.2019.02.023
35. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines): Central Nervous System Cancers Version 2.2021. National Comprehensive Cancer Network (NCCN). Updated September 8, 2021. Accessed February 22, 2022.  
[https://www.nccn.org/professionals/physician\\_gls/pdf/cns.pdf](https://www.nccn.org/professionals/physician_gls/pdf/cns.pdf)
36. American College of Radiology. ACR Appropriateness Criteria® Cervical Neck Pain or Cervical Radiculopathy. American College of Radiology. Updated 2018. Accessed November 9, 2021. <https://acsearch.acr.org/docs/69426/Narrative/>
37. Ziu E, Viswanathan VK, Mesfin FB. Spinal Metastasis. StatPearls Publishing. Updated August 27, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK441950/>
38. American College of Radiology. ACR Appropriateness Criteria® Suspected Spine Infection. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021.  
<https://acsearch.acr.org/docs/3148734/Narrative/>
39. Lener S, Hartmann S, Barbagallo GMV, Certo F, Thomé C, Tschugg A. Management of spinal infection: a review of the literature. *Acta Neurochir (Wien)*. Mar 2018;160(3):487-496. doi:10.1007/s00701-018-3467-2

40. Bond A, Manian FA. Spinal Epidural Abscess: A Review with Special Emphasis on Earlier Diagnosis. *Biomed Res Int*. 2016;2016:1614328. doi:10.1155/2016/1614328
41. Berbari EF, Kanj SS, Kowalski TJ, et al. 2015 Infectious Diseases Society of America (IDSA) Clinical Practice Guidelines for the Diagnosis and Treatment of Native Vertebral Osteomyelitis in Adults. *Clin Infect Dis*. Sep 15 2015;61(6):e26-46. doi:10.1093/cid/civ482
42. American College of Radiology. ACR Appropriateness Criteria® Inflammatory Back Pain: Known or Suspected Axial Spondyloarthritis. American College of Radiology (ACR). Updated 2021. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3094107/Narrative/>
43. Zalatio O. Tethered Spinal Cord Syndrome. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 10, 2021. <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Tethered-Spinal-Cord-Syndrome>
44. Düz B, Gocmen S, Secer HI, Basal S, Gönül E. Tethered cord syndrome in adulthood. *J Spinal Cord Med*. 2008;31(3):272-8. doi:10.1080/10790268.2008.11760722
45. Milhorat TH, Bolognese PA, Nishikawa M, et al. Association of Chiari malformation type I and tethered cord syndrome: preliminary results of sectioning filum terminale. *Surg Neurol*. Jul 2009;72(1):20-35. doi:10.1016/j.surneu.2009.03.008
46. Morimoto K, Takemoto O, Wakayama A. Tethered cord associated with anorectal malformation. *Pediatr Neurosurg*. Feb 2003;38(2):79-82. doi:10.1159/000068048
47. Kim SM, Chang HK, Lee MJ, et al. Spinal dysraphism with anorectal malformation: lumbosacral magnetic resonance imaging evaluation of 120 patients. *J Pediatr Surg*. Apr 2010;45(4):769-76. doi:10.1016/j.jpedsurg.2009.10.094
48. Zywicke HA, Rozzelle CJ. Sacral dimples. *Pediatr Rev*. Mar 2011;32(3):109-13; quiz 114, 151. doi:10.1542/pir.32-3-109
49. American College of Radiology. ACR Appropriateness Criteria® Headache. American College of Radiology. Updated 2019. Accessed November 1, 2021. <https://acsearch.acr.org/docs/69482/Narrative/>
50. American College of Radiology. ACR Appropriateness Criteria® Headache-Child. American College of Radiology. Updated 2017. Accessed November 10, 2021. <https://acsearch.acr.org/docs/69439/Narrative/>
51. Strahle J, Smith BW, Martinez M, et al. The association between Chiari malformation Type I, spinal syrinx, and scoliosis. *J Neurosurg Pediatr*. Jun 2015;15(6):607-11. doi:10.3171/2014.11.Peds14135
52. Juvenile Scoliosis. Scoliosis Research Society (SRS). Updated 2021. Accessed November 10, 2021. <https://www.srs.org/professionals/online-education-and-resources/conditions-and-treatments/juvenile-scoliosis>
53. American College of Radiology. ACR Appropriateness Criteria® Scoliosis-Child. American College of Radiology. Updated 2018. Accessed November 10, 2021. <https://acsearch.acr.org/docs/3101564/Narrative/>
54. Trenga AP, Singla A, Feger MA, Abel MF. Patterns of congenital bony spinal deformity and associated neural anomalies on X-ray and magnetic resonance imaging. *J Child Orthop*. Aug 2016;10(4):343-52. doi:10.1007/s11832-016-0752-6

55. Ozturk C, Karadereler S, Ornek I, Enercan M, Ganiyusufoglu K, Hamzaoglu A. The role of routine magnetic resonance imaging in the preoperative evaluation of adolescent idiopathic scoliosis. *Int Orthop*. Apr 2010;34(4):543-6. doi:10.1007/s00264-009-0817-y
56. Strahle J, Muraszko KM, Kapurch J, Bapuraj JR, Garton HJ, Maher CO. Chiari malformation Type I and syrinx in children undergoing magnetic resonance imaging. *J Neurosurg Pediatr*. Aug 2011;8(2):205-13. doi:10.3171/2011.5.Peds1121
57. Radic JAE, Cochrane DD. Choosing Wisely Canada: Pediatric Neurosurgery Recommendations. *Paediatr Child Health*. Sep 2018;23(6):383-387. doi:10.1093/pch/pxy012
58. Hertzler DA, 2nd, DePowell JJ, Stevenson CB, Mangano FT. Tethered cord syndrome: a review of the literature from embryology to adult presentation. *Neurosurg Focus*. Jul 2010;29(1):E1. doi:10.3171/2010.3.Focus1079
59. Shah LM, Salzman KL. Imaging of spinal metastatic disease. *Int J Surg Oncol*. 2011;2011:769753. doi:10.1155/2011/769753
60. Chhetri SK, Gow D, Shaunak S, Varma A. Clinical assessment of the sensory ataxias; diagnostic algorithm with illustrative cases. *Pract Neurol*. Aug 2014;14(4):242-51. doi:10.1136/practneurol-2013-000764
61. Foster H, Drummond P, Jandial S, Clinch J, Wood M, Driscoll S. Evaluation of gait disorders in children. BMJ Best Practice. Updated February 23, 2021. Accessed November 2, 2021. <https://bestpractice.bmj.com/topics/en-us/709>
62. Stanford Medicine. Gait Abnormalities. Stanford University. Updated 2021. Accessed November 2, 2021. <https://stanfordmedicine25.stanford.edu/the25/gait.html>
63. Haynes KB, Wimberly RL, VanPelt JM, Jo CH, Riccio AI, Delgado MR. Toe Walking: A Neurological Perspective After Referral From Pediatric Orthopaedic Surgeons. *J Pediatr Orthop*. Mar 2018;38(3):152-156. doi:10.1097/bpo.0000000000001115
64. Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurol Clin Pract*. Jun 2012;2(2):103-111. doi:10.1212/CPJ.0b013e31825a7823
65. Pirker W, Katzenschlager R. Gait disorders in adults and the elderly : A clinical guide. *Wien Klin Wochenschr*. Feb 2017;129(3-4):81-95. doi:10.1007/s00508-016-1096-4
66. Sieper J, Rudwaleit M, Baraliakos X, et al. The Assessment of SpondyloArthritis international Society (ASAS) handbook: a guide to assess spondyloarthritis. *Ann Rheum Dis*. Jun 2009;68 Suppl 2:ii1-44. doi:10.1136/ard.2008.104018
67. Akgul O, Ozgocmen S. Classification criteria for spondyloarthropathies. *World J Orthop*. Dec 18 2011;2(12):107-15. doi:10.5312/wjo.v2.i12.07
68. Bennett AN, Marzo-Ortega H, Rehman A, Emery P, McGonagle D. The evidence for whole-spine MRI in the assessment of axial spondyloarthropathy. *Rheumatology (Oxford)*. Mar 2010;49(3):426-32. doi:10.1093/rheumatology/kep427
69. Ostergaard M, Lambert RG. Imaging in ankylosing spondylitis. *Ther Adv Musculoskelet Dis*. Aug 2012;4(4):301-11. doi:10.1177/1759720x11436240
70. Graeber A, Cecava ND. Vertebral Osteomyelitis. StatPearls Publishing. Updated July 22, 2021. Accessed November 10, 2021. <https://www.ncbi.nlm.nih.gov/books/NBK532256/>
71. Dias M, Partington M. Congenital Brain and Spinal Cord Malformations and Their Associated Cutaneous Markers. *Pediatrics*. Oct 2015;136(4):e1105-19. doi:10.1542/peds.2015-2854

72. D'Alessandro DM. Does This Sacral Dimple Need to be Evaluated? PediatricEducation.org™. Updated July 20, 2009. Accessed November 10, 2021. <https://pediatriceducation.org/2009/07/20/does-this-sacral-dimple-need-to-be-evaluated/>
73. Patel NT, Rizk EB, Simon SD. Spina Bifida. American Association of Neurological Surgeons (AANS). Updated 2021. Accessed November 11, 2021. <https://www.aans.org/en/Patients/Neurosurgical-Conditions-and-Treatments/Spina-Bifida>
74. Ahmed A. MRI features of disseminated 'drop metastases'. *S Afr Med J*. Jul 2008;98(7):522-3.
75. Batool A, Kasi A. Leptomeningeal Carcinomatosis. StatPearls Publishing Copyright © 2022, StatPearls Publishing LLC. Updated March 25, 2021. Accessed February 25, 2022. <https://www.ncbi.nlm.nih.gov/books/NBK499862/>

### **ADDITIONAL RESOURCES**

- 1. Davis PC, Wippold FJ, 2nd, Brunberg JA, et al. ACR Appropriateness Criteria on low back pain. *J Am Coll Radiol*. Jun 2009;6(6):401-7. doi:10.1016/j.jacr.2009.02.008**
- 2. Tethered Spinal Cord Syndrome Information Page. National Institute of Neurological Disorders and Stroke (NINDS). Updated March 27, 2019. Accessed November 11, 2021. <https://www.ninds.nih.gov/Disorders/All-Disorders/Tethered-Spinal-Cord-Syndrome-Information-Page>**
- 3. Pomerantz SR. Myelography: modern technique and indications. *Handb Clin Neurol*. 2016;135:193-208. doi:10.1016/b978-0-444-53485-9.00010-6**
- 4. Willén J, Wessberg PJ, Danielsson B. Surgical results in hidden lumbar spinal stenosis detected by axial loaded computed tomography and magnetic resonance imaging: an outcome study. *Spine (Phila Pa 1976)*. Feb 15 2008;33(4):E109-15. doi:10.1097/BRS.0b013e318163f9ab**

**Reviewed / Approved by NIA Clinical Guideline Committee**

### **GENERAL INFORMATION**

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

**Disclaimer:** Magellan Healthcare service authorization policies do not constitute medical advice and are not intended to govern or otherwise influence the practice of medicine. These policies are not meant to supplant your normal procedures, evaluation, diagnosis, treatment and/or care plans for your patients. Your professional judgement must be exercised and followed in all respects with regard to the treatment and care of your patients. These policies apply to all Magellan Healthcare subsidiaries including, but not limited to, National Imaging Associates ("Magellan"). The policies constitute only the reimbursement and coverage guidelines of Magellan. Coverage for services varies for individual members in accordance with the terms and conditions of applicable Certificates of Coverage, Summary Plan Descriptions, or contracts with governing regulatory agencies. Magellan reserves the right to review and update the guidelines at its sole discretion. Notice of such changes, if necessary, shall be provided in accordance with the terms and conditions of provider agreements and any applicable laws or regulations.